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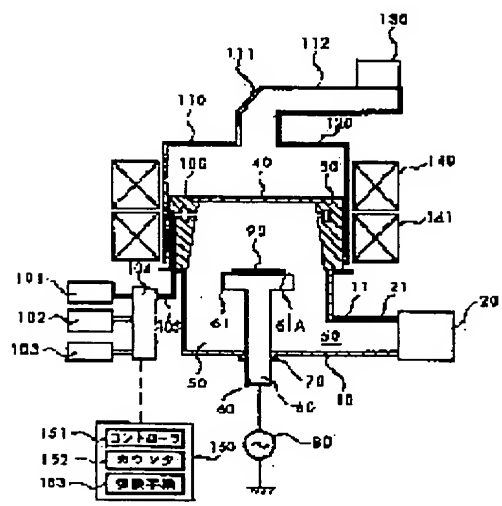
## (54) PLASMA PROCESSING DEVICE AND METHOD

(57)Abstract:
PURPOSE: To provide a plasma processing device and a method in which fluorine atom-containing gas plasma is used, wherein plasma processing is prevented from deteriorating in rate.
CONSTITUTION: A plasma processing device is equipped with a plasma generating device 130, a vacuum chamber 50, and a processing means which processes a specimen 90 with processing gas plasma in the vacuum chamber 50, wherein processing etching gas is introduced into the vacuum chamber 50 from a gas resource 101, microwaves are applied to etching gas to turn it into plasma, and then the specimen 90 is etched with the plasma. On the condition that the processed specimens, for instance, reach to a prescribed number, the inside of the vacuum chamber 50 is subjected to a reforming process where the part of the chamber 50 brought into contact with processing gas is removed by etching. First, a dummy substrate is introduced into the vacuum chamber 50 in place of a specimen, reforming gas is introduced into the vacuum chamber 50 from gas sources 102 and 103 and turned into plasma. The inner wall of the vacuum chamber 50 is thinly removed by the plasma.



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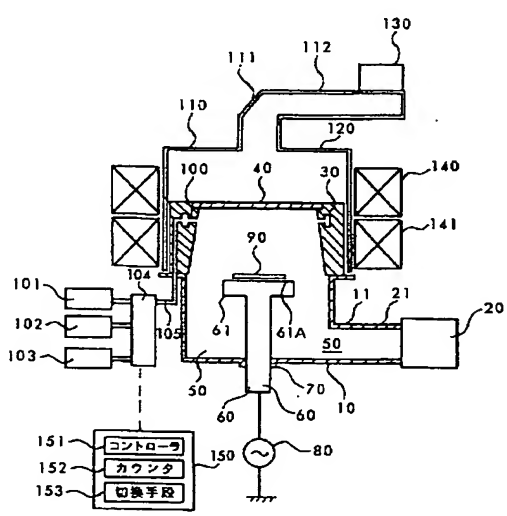
(54)【発明の名称】　プラズマ処理装置およびプラズマ処理方法

(57)【要約】
【目的】フッ素原子を含むガスプラズマを使用するプラズマ処理において、プラズマ処理速度の低下を防止したプラズマ処理装置およびプラズマ処理方法を提供する。
【構成】プラズマ発生装置１３０と、真空容器５０と、真空容器内で処理ガスのプラズマを用いて試料を処理する手段とを備えたプラズマ処理装置において、まず、真空容器に、ガス源１０１から処理用のエッチングガスを導入し、このエッチングガスにマイクロ波を印加してプラズマを発生させ、試料９０をエッチング処理する。所定の条件、例えば処理枚数が所定値に達したら、真空容器内をリフオーミング処理、すなわち処理用のガスに触れた部分をエッチングにより除去する処理に進む。まず、試料の代りに、ダミーの基板を真空容器内に搬入し、次に、ガス源１０２，１０３からリフオーミング用のガスを導入し、このガスをプラズマ化する。このプラズマによって真空容器の壁面を薄く除去する。

図　3




30…放電ブロック　40…マイクロ波透過窓
61…試料台　90…試料　110〜112…導波管
130…マグネトロン　140，141…空心コイル

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CLAIMS

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[Claim(s)]
[Claim 1] In the plasma treatment approach by plasma treatment equipment equipped with the plasma generator and the vacuum processing room, in the step which plasma-izes raw gas with said plasma generator, and said vacuum processing interior of a room With the step which processes a sample using the plasma of this raw gas, and said plasma generator The plasma treatment approach which consists of a step which plasma-izes reforming gas, and a step which carries out reforming of the part which touched said raw gas in said plasma treatment equipment using the plasma of this reforming gas.
[Claim 2] In the plasma treatment approach by plasma treatment equipment equipped with the plasma generator and the vacuum processing room, in the step which plasma-izes raw gas with said plasma generator, and said vacuum processing interior of a room With the step which processes a sample using the plasma of this raw gas, and said plasma generator With the step which plasma-izes cleaning gas, the step which cleans the deposit which adhered in said plasma treatment equipment using the plasma of said cleaning gas by processing of said sample, and said plasma generator The plasma treatment approach characterized by what is consisted of a step which plasma-izes reforming gas, and a step which carries out reforming of the part which touched said raw gas in plasma treatment equipment using the plasma of this reforming gas.
[Claim 3] With plasma treatment equipment equipped with the plasma generator and the vacuum processing room, in the plasma treatment approach of processing a sample for every sheet in the step which plasma-izes raw gas with said plasma generator, and said vacuum processing interior of a room With the step which processes said sample for every sheet using the plasma of this raw gas, and said plasma generator With the step which plasma-izes cleaning gas, the step which cleans the deposit which adhered in said plasma treatment equipment using the plasma of said cleaning gas by processing of said sample, and said plasma generator The step which plasma-izes reforming gas, and the step which carries out reforming of the part which touched said raw gas in plasma treatment equipment using the plasma of this reforming gas, The plasma treatment approach characterized by what the step which seasoning gas is introduced into said vacuum processing room, this seasoning gas is plasma-ized, and it tames for making in agreement the processing conditions of the first sheet of said sample and the n-th sheet, and performs electrodischarge treatment is included for.
[Claim 4] The plasma treatment approach according to claim 1, 2, or 3 characterized by what is done for reforming of the part which touched said raw gas in said plasma treatment equipment using the plasma of said reforming gas whenever it processes said sample for every sheet using the plasma of this raw gas and reaches predetermined processing conditions in said vacuum processing interior of a room.

[Claim 5] The plasma treatment approach according to claim 4 characterized by what should be given to said predetermined processing conditions when predetermined number-of-sheets processing of said sample is carried out.
[Claim 6] The plasma treatment approach according to claim 4 characterized by what should be given to said predetermined processing conditions when the electric resistance of the wall surface of said vacuum processing room is measured and the value of this electric resistance exceeds a predetermined value.
[Claim 7] Whenever it processes said sample for every sheet using the plasma of this raw gas and carries out predetermined number-of-sheets processing of said sample in said vacuum processing interior of a room, with said plasma generator With the step which plasma-izes cleaning gas, the step which cleans the deposit which adhered in said plasma treatment equipment using the plasma of said cleaning gas by processing of said sample, and said plasma generator The step which plasma-izes reforming gas, and the step which carries out reforming of the part which touched said raw gas in plasma treatment equipment using the plasma of this reforming gas, The plasma treatment approach according to claim 1, 2, or 3 characterized by what the step which seasoning gas is introduced into said vacuum processing room, this seasoning gas is plasma-ized, and it tames for making in agreement the processing conditions of the 1st sheet of said sample and the n-th sheet, and performs electrodischarge treatment is repeated for.
[Claim 8] The plasma treatment approach according to claim 1, 2, or 3 characterized by the thing using chlorine gas as said reforming gas by the wall of said vacuum processing room consisting of an aluminum ingredient.
[Claim 9] The plasma treatment approach according to claim 1, 2, or 3 which the wall of said vacuum processing room consists of an ingredient containing silicon, and is characterized by the thing using fluorocarbon gas as said reforming gas.
[Claim 10] In the plasma treatment approach by plasma treatment equipment equipped with the plasma generator and the vacuum processing room, the raw gas which contains chlorine and a fluorine with said plasma generator in the plasma-ized step and said vacuum processing interior of a room With the step which carries out etching processing of the sample which has the silicon oxide film using the plasma of this raw gas, and said plasma generator The plasma treatment approach of a sample of having the oxidation silicone film characterized by what the step which plasma-izes reforming gas, and the step which carries out reforming of the part which touched said raw gas in said plasma treatment equipment using this reforming gas are included for.
[Claim 11] In the plasma treatment approach by plasma treatment equipment equipped with the plasma generator and the vacuum processing room, the raw gas which contains chlorine and a fluorine with said plasma generator in the plasma-ized step and said vacuum processing interior of a room With the step which carries out etching processing of the sample which has a silicon nitride film using the plasma of this raw gas, and said plasma generator The plasma treatment approach of a sample of having the silicon nitride film characterized by what the step which plasma-izes reforming gas, and the step which carries out reforming of the part which touched said raw gas in said plasma treatment equipment using this reforming gas are included for.
[Claim 12] The reforming approach of the plasma treatment equipment characterized by what reforming gas is plasma-ized and is done using the plasma of this reforming gas for the specified quantity clearance of the part for the wall of said vacuum processing room with said plasma generator in an approach at reforming of plasma treatment equipment equipped with the plasma generator and the vacuum processing room.
[Claim 13] In plasma treatment equipment equipped with the plasma generator, the

vacuum processing room, a means to supply the raw gas of a sample to this vacuum processing room, and a means to process said sample in this vacuum processing interior of a room using the plasma of said raw gas With a means to supply reforming gas to said vacuum processing room, and said plasma generator Plasma treatment equipment characterized by what said reforming gas is plasma-ized and the means which carries out reforming of the part which touched said raw gas in said plasma treatment equipment is included for using this reforming gas.
[Claim 14] In plasma treatment equipment equipped with the plasma generator, the vacuum processing room, a means to supply the raw gas of a sample to this vacuum processing room, and a means to process said sample in this vacuum processing interior of a room using the plasma of said raw gas With a means to supply cleaning gas to said vacuum processing room, and said plasma generator A means to remove the deposit which plasma-ized cleaning gas and adhered in said plasma treatment equipment by processing of said sample using the plasma of said cleaning gas, With a means to supply reforming gas to said vacuum processing room, and said plasma generator Plasma treatment equipment characterized by what said reforming gas is plasma-ized and the means which carries out reforming of the part which touched said raw gas in said plasma treatment equipment is included for using this reforming gas.
[Claim 15] Plasma treatment equipment according to claim 12 or 13 with which it is characterized by what it had for the control unit which operates a means to supply said reforming gas, and the means which carries out reforming of the part which touched said raw gas in said plasma treatment equipment by said reforming gas whenever processing of said sample in said vacuum processing room reaches predetermined processing conditions.
[Claim 16] Plasma treatment equipment according to claim 14 characterized by what it had a means to measure the electric resistance of the wall surface of said vacuum processing room for in order that processing of said sample might detect reaching predetermined processing conditions.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the plasma treatment equipment which processes etching etc. to a processed material using the plasma of a plasma etching system, plasma-CVD equipment, etc., and the plasma treatment approach.
[0002]
[Description of the Prior Art] The corrosive high gas by which the vacuum processing room of plasma treatment equipments, such as a plasma etching system and plasma-CVD equipment, contains chlorine, a fluorine, etc. has come to be used with detailed-izing of LSI, and high integration. Stainless steel, quartz-glass alumina ceramics, etc. were conventionally used as an ingredient with high corrosion resistance to these gas. In addition, JP,62-103379,A is mentioned as this kind of equipment.
[0003]
[Problem(s) to be Solved by the Invention] When using stainless steel for the vacuum processing room of plasma treatment equipment, in order for the stainless steel itself to emit Fe, nickel, Co, etc. which are the configuration element by the impact of the charged particle in the plasma, there is a problem of causing heavy metal pollution, in manufacture of a semiconductor device.
[0004] On the other hand, although there is no problem of heavy metal pollution if quartz-glass covering is used, by the impact and thermal radiation of the plasma, the temperature may rise with time and a processing property may be changed. In such a case, although it is effective to heat or cool quartz glass with a certain means, in the case of plasma treatment equipment, there is a problem that it is structural and technically difficult in many cases, according to situations, such as touching touching a vacuum and the plasma.
[0005] Although an aluminum ingredient is raised as an ingredient which is rich in the workability which heavy metal pollution does not have, either and also includes heating or cooling, there is a fault which is when there is no corrosion resistance over the gas plasma containing the chlorine atom or fluorine atom used with plasma treatment equipment in this case. As a cure to this, there is the approach of forming the coat which was excellent in corrosion resistance, such as A12O3, A1C, TiN and SiC, and A1N, on the front face of an aluminum ingredient with a certain means, for example like the publication to JP,62-103379,A.
[0006] However, with the plasma treatment equipment which uses the gas containing a fluorine atom, the cure for bringing about degradation of a processing property with time was not made by fluorinating the ingredient itself which constitutes a processing room.
[0007] In the plasma treatment which uses the gas plasma containing a fluorine atom, the object of this invention makes small fluctuation of the process property

accompanying progress of the fluoride of a processing room ingredient, and is to offer the plasma treatment equipment which prevented lowering of a plasma treatment rate, and the plasma treatment approach.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned object, this invention is characterized by carrying out reforming of the part which plasma-ized reforming gas and touched the raw gas in plasma treatment equipment using this reforming gas with the plasma generator.

[0009] According to other descriptions of this invention, moreover, a plasma generator and a vacuum processing room, In plasma treatment equipment equipped with a means to supply the raw gas of a sample to this vacuum processing room, and a means to process said sample in this vacuum processing interior of a room using the plasma of said raw gas With a means to supply reforming gas to a vacuum processing room, and the plasma generator, reforming gas is plasma-ized and the means which carries out reforming of the part which touched the raw gas in plasma treatment equipment is included using this reforming gas.

[0010]

[Function] According to the plasma treatment approach of this invention, first, the etching gas for processing is introduced into a processing room, i.e., a vacuum housing, a RF is impressed to this etching gas, and the plasma is generated. Next, etching processing of the sample is carried out. A sample is processed for every sheet like the following.

[0011] If a predetermined value is reached, predetermined conditions, for example, processing number of sheets, it will progress to the processing which removes thinly the part which touched the gas for reforming (playback) processing, i.e., processing, with the inside of a vacuum housing by reforming, i.e., etching. First, instead of a sample, a dummy substrate is carried in in a vacuum housing, next the gas for reforming is introduced, and this gas is plasma-ized. Reforming of the wall surface of a vacuum housing is carried out by this plasma. By this reforming processing, the inner surface of a processing ingredient is removed thinly and it returns to the again same condition as an initial state.

[0012] In addition, cleaning treatment of the deposit produced in etching processing before reforming processing may be performed. That is, cleaning gas is introduced in a vacuum housing, this gas is plasma-ized, and deposits, such as a resultant adhering to the cleaning in a vacuum housing, the wall of **, etc., are removed.

[0013]

[Example] Hereafter, one example of this invention is explained according to drawing. Drawing 1 is drawing for explaining the principle of the plasma treatment approach of this invention. That is, it is drawing showing change of the wall surface of the vacuum processing room 10 of a microwave plasma etching system. First, as shown in (A), when a sample is first carried in to the vacuum processing room 10, there is no adhesion of a deposit in the wall surface of a vacuum processing room, and there is also no trespass of fluorine gas. The condition after carrying out predetermined number-of-sheets etching processing of the sample comes to be shown in (B), and remarkable deposit layer 10A and fluorine gas trespass layer 10B are formed in a wall surface. Then, as shown in (C), the deposit of the front face of a vacuum processing room is removed by performing cleaning/depository clearance processing. In addition, the part may remain without removing a deposit thoroughly. Next, by performing reforming processing about the part equivalent to fluoride thickness, as shown in (D), Kabeuchi's fluorine gas trespass layer is also removed and it recovers in the same condition as the first (A). In addition, cleaning/depository clearance processing has the work which makes reforming processing following it easy.

[0014] Drawing 2 shows the material-list side when exposing to the RF plasma containing a fluorine using the general aluminum material as a component of **, such as a vacuum processing room of a microwave plasma etching system, and aging of fluoride thickness. A broken line shows the case where any measures are not taken, either, and it turns out that fluoride thickness increases as a function of plasma treatment time amount so that clearly from drawing. According to the experiment, at the vacuum processing room which consisted of aluminum ingredients, when 1,000 samples were processed, the fluoride thickness of the wall surface of a vacuum processing room amounted to about 1.0 micrometers.
[0015] Hereafter, in this description, the language "aluminum ingredient" shall put pure aluminium and an aluminum alloy.
[0016] Drawing 3 is important section drawing of longitudinal section of the microwave plasma etching system of this invention which performs plasma treatment with the application of the principle of drawing 1 .
[0017] In drawing 3 , the wall of a vacuum housing 10 is formed with aluminum. Vacuum housing 10 crowning serves as a plane view approximate circle form. The exhaust nozzle 11 is formed in the side-attachment-wall pars basilaris ossis occipitalis of a vacuum housing 10, and this exhaust nozzle 11 and the inlet port of the evacuation equipment 20 currently installed out of the vacuum housing 10 are connected with it with the exhaust pipe 21. The closing motion valve, the exhaust-back-pressure adjustable valve, etc. are prepared in the exhaust pipe 21 (graphic display abbreviation).
[0018] 30 is the discharge block 30 which has a plasma production field inside, and the configuration is a hollow cylinder with little cross-section change to the travelling direction of microwave. The axial center of that inside centrum is used as abbreviation vertical axes, and this inside centrum is opened for free passage by the vacuum housing 10 through the circular disconnection section of a vacuum housing 10, and the discharge block 30 is airtightly assembled by the top wall of a vacuum housing 10. The upper bed section of an inside centrum is airtightly closed in the crowning of the discharge block 30, and the microwave transparency aperture 40 is formed in it. This microwave transparency aperture 40 is formed with microwave transparency ingredients, such as a quartz and an alumina. Thus, the space 50 intercepted from the outside is formed in the vacuum housing 10 of the inside centrum and the microwave transparency aperture 40 of the discharge block 30.
[0019] 60 is sample ****, the upper part projects in a projection in space 50, and the lower part projects out of a vacuum housing 10. The bottom wall and sample **** 60 of a vacuum housing 10 are electrically insulated by the electric insulation member 70. The sample base 61 has sample installation side 61A on the top face. The sample base 61 is established in the upper bed of sample **** 60 by making the sample installation side into the abbreviation level surface. In addition, even if sample **** 60 and the sample base 61 are formed in one, it is easy to be natural [ the base ]. Out of space 50, RF generator 80 which is a power source for bias is installed. Sample **** 60 is connected to RF generator 80. The other end of RF generator 80 is grounded, and both sample **** 60 and the sample base 61 are formed with the electrical conducting material, therefore the sample base 61 is in sample **** 60 and switch-on.
[0020] On the other hand, a vacuum housing 10 is grounded and the discharge block 30 is also grounded through the vacuum housing 10. In addition, in addition to this as a power source for bias, the activity of DC power supply etc. is also possible. Moreover, refrigerant passage is formed in the interior of the sample base 61, it is open for free passage to refrigerant passage, and a refrigerant supply way and refrigerant exhaust passage are formed in the interior of sample **** 60, respectively

(graphic display abbreviation). Moreover, the refrigerant feeder is installed outside space 50.

[0021] The microwave transparency aperture 40 and sample installation side 61A (when the samples 90, such as a semiconductor device substrate, are installed in this sample installation side, it is the processed side) of the sample base 61 will be in the condition of having countered in the vertical direction, and those fields will be in an abbreviation parallel condition. In addition, it is desirable to be constituted so that the core of sample installation side 61A of the axial center of the inside centrum of the discharge block 30, the core of the micro transparency aperture 40, and the sample base 61, i.e., the processed side of a sample 90, may carry out abbreviation coincidence, respectively.

[0022] The gas supply way 100 is formed in the interior of the discharge block 30. On the other hand, the source 101 of etching raw gas, the source 102 for cleaning of O2 gas, BCl3 gas for reforming and the source 103 of Cl2 gas, and the source of seasoning gas (graphic display abbreviation) are installed out of space 50. Each sources 101, 102, and 103 of gas and the end of the gas supply way 100 are connected through the diverter valve 104 and the gas supply line 105. The closing motion valve, the quantity-of-gas-flow controller (graphic display abbreviation), etc. are formed in the gas supply line 105. Opening of the other end of the gas supply way 100 is carried out to the inside centrum of the discharge block 30.

[0023] The waveguide 110 is arranged in the outside of block 30 where this block 30 is included inside. Termination of the waveguide 110 is carried out by the vacuum housing 10. The configuration of a waveguide 110 is a cylindrical shape. Between the top walls and the upper bed aspects (top face of the microwave transparency aperture 40) of the discharge block 30 which are the closedown end wall of a waveguide 110, the space 120 which has predetermined height (spacing) is formed. Opening is formed in the top face of the microwave transparency aperture 40 of the top wall of a waveguide 110, and the part which counters.

[0024] Out of space 50,120, the magnetron 130 which is a means to oscillate microwave is formed. The magnetron 130 and the waveguide 110 are connected with waveguides 111 and 112. The inside of a waveguide 111 and 112 is in space 120 and a free passage condition through opening of the top wall of a waveguide 110. Here, a waveguide 111 is a waveguide a rectangle and for circular right-angle conversion, and a waveguide 112 is a rectangular waveguide. In addition, the magnetron 130 and the waveguide 110 may be connected with other microwave propagation means, for example, a coaxial cable etc.

[0025] Two steps of air cored coils 140 and 141 which are means to generate a field on the side-attachment-wall periphery of a waveguide 1110 are fastened in the height direction. Furthermore, an air cored coil 140 is carried out in space 120, and the air cored coil 141 is made to carry out an abbreviation response by the periphery side face of the discharge block 30. Air cored coils 140 and 141 are connected to the power source respectively through the ON-OFF means, the amount accommodation means of energization, etc. (graphic display abbreviation).

[0026] 150 is a control means and has the controller 151 which controls a well-known conveyance means (graphic display abbreviation), and carries in one sample 90 at a time in a vacuum housing 10 and to control, and the counter 152 which measures the carrying-in number of sheets of a sample 90. Moreover, 153 is a switch means, and if the processing number of sheets of a sample 90 reaches a predetermined value, it will switch the source 102 for cleaning of O2 gas, and the source 103 of gas and the source of seasoning gas for reforming so that the cleaning and reforming processing in a vacuum housing may be performed. [ the source 101 of etching raw gas, and ]

[0027] Next, drawing 4 explains the flow of the etching art of this invention. First, a sample 90 is carried in in a vacuum housing 10 (step 402). That is, only one sample 90 is carried in in a vacuum housing 10 with a well-known conveyance means. The conveyance means which carried in the sample 90 in the vacuum housing 10 is evacuated to the location which does not check processing of a sample 90. The sample 90 passed to the sample base 61 is installed in sample installation side 61A of the sample base 61 in a processed side overhead position. A closing motion valve and an exhaust-back-pressure adjustable valve are opened, evacuation equipment 20 is operated, and space 50 is evacuated (404). Furthermore, the gas for etching is introduced into space 50 (406). That is, the gas for etching predetermined by the predetermined flow rate is introduced into the inside centrum of the discharge block 30 from the source 101 of raw gas through a gas supply line 105, a diverter valve 104, and the gas supply way 100. A part of gas for etching introduced into space 50 is exhausted by accommodation through evacuation equipment 20 whenever [ valve-opening / of an exhaust-back-pressure adjustable valve ], and, thereby, the pressure of space 50 is adjusted by the predetermined etching processing pressure force.
[0028] Moreover, air cored coils 140 and 141 operate and a field is impressed to the inside centrum of the discharge block 30. Next, the gas for etching in space 50 is plasma-ized using the microwave which occurred in the magnetron 130 and was drawn with the waveguide 110 (step 408). By this plasma, etching processing of $SiO_2$ of a sample is carried out (410). Furthermore, the inside of a vacuum housing 10 is exhausted with termination of etching processing (412), and a sample 90 is taken out out of a vacuum housing 10 (step 414). A sample 90 is carried in and processed for every sheet in a vacuum housing 10 like the following.
[0029] If counting of the processing number of sheets of a sample 90 is carried out and processing number of sheets reaches a predetermined value, for example, 25 sheets, (416), in order to remove the affix and fluoride layer of vacuum housing 10 front face which were generated by processing of a sample 90, it progresses to cleaning and reforming processing (418 or less step).
[0030] That is, when generating the plasma and carrying out plasma treatment by the gas containing a fluorine, an affix follows on a processing indoor side gradually. For this reason, it is necessary to clean every [ every sheet and ] two or more sheets. As gas which performs this cleaning, it is desirable to use oxygen content gas. In cleaning treatment, after carrying in a dummy substrate in a vacuum housing (418) and exhausting the inside of a vacuum housing 10 to a high vacuum instead of a sample 90 first (420), the diverter valve 104 of the gas supply way 100 is controlled, and $O_2$ gas for gas ** cleaning is introduced (422). Next, this $O_2$ gas is plasma-ized (424) and deposits, such as a resultant adhering to the cleaning in a vacuum housing, i.e., the wall of ** etc., are removed (426).
[0031] Next, after exhausting the inside of a vacuum housing 10, BCl [ for reforming ]3 and $Cl_2$ gas is introduced (430), and this gas is plasma-ized (432). the plasma-ized reforming gas -- the wall surface of a vacuum housing 10 etc. -- reforming -- that is, it is removed thinly (434). The amount removed is set to 0.004 micrometers per sample, and 0.1 micrometers every 25 sheets. The desirable values of etching are 0.001-0.016 micrometers per sample, and about 0.025-0.4 micrometers per 25 samples. Finally the inside of a vacuum housing is exhausted (436), and reforming is completed.
[0032] Next, in order to perform seasoning processing, seasoning gas is introduced into a vacuum housing 10 (438), this gas is plasma-ized (440), and seasoning is performed (442). Seasoning is tamed for making in agreement the processing conditions (the temperature of each part, condition of the front face of a vacuum housing 10, etc.) of the 1st sheet of a sample, and the n-th sheet (for example, n=

25), and is generic names, such as discharge, here. And the inside of a vacuum housing 10 is exhausted (444), a dummy substrate is discharged (446), and a series of processings are completed.

[0033] In addition, it is more desirable to perform seasoning, before replacing with the example of drawing 4 and carrying in the first sample after a start.

[0034] The processing conditions of each step, and the class of gas and an example of gas pressure are shown in drawing 5 .

[0035] In addition, the gas in the case of etching the silicon oxide film formed on the substrate of polish recon in etching processing as the photoresist by which patterning was carried out is little ********** about CH2F2 gas to CHF3 or this gas.

[0036] The gas in the case of etching the silicon oxide film formed on the substrate of silicon nitride as the photoresist by which patterning was carried out is [ C4F8 gas or ] abundant ********** about rare gas or carbon monoxide gas to this gas.

[0037] CH2F2, CHF(s)3, or these mixed gas is used for the gas in the case of etching the silicon nitride film formed on the polish recon substrate as the photoresist by which patterning was carried out. Gas pressure sets all three upper cases to 0.5 - 10mTorr, when using microwave.

[0038] In addition, although the case of aluminum was described as construction material of a processing room until now, it is not limited to this. There is a thing to which the film (mullite etc.) which used as the principal component the thing, alumina film (A12O3), or alumina which carried out alumite processing of the front face of aluminum was made to adhere, or effectiveness that other metal and other insulating materials (film and simple substance) are the same.

[0039] Moreover, the example of the combination of the gas used for drawing 6 at a component and reforming, such as a vacuum housing, is shown. Thus, the gas used for reforming changes with the ingredient which constitutes the processor of vacuum housing 10 grade. That is, it must be gas removable to homogeneity about the ingredient which constitutes a processor.

[0040] Drawing 7 is drawing showing the effectiveness of this invention. If it is the conventional approach, in order that a fluoride layer may grow with the increment in the etching processing number of sheets of a sample, as a broken line shows, etching processing speed falls. Even if the etching processing number of sheets of a sample increases as a continuous line shows since growth of a fluoride layer is pressed down by carrying out reforming of the wall surface of a vacuum processing room to this according to this invention, etching processing speed is maintained almost uniformly. Whenever it processes 25 samples, supposing it deletes 0.2 micrometers of wall surfaces of a vacuum processing room at a time on both sides, when 15,000 sheets are processed, the amount of etching of a wall surface is set to 120 micrometers. In the dimensional change of a vacuum processing room of this level, trouble is not practically caused to etching processing of a sample at all. The period of reforming and the amount of shaving of a wall surface can be suitably set up according to the etching processing conditions of a sample etc.

[0041] Although the example shown in drawing 4 showed the example which performs cleaning/depository clearance processing and reforming for every etching processing number of sheets of a fixed sample, if the monitor of the gas trespass situation to the wall surface of a vacuum processing room is carried out and predetermined conditions are reached as an approach of replacing with this, depository clearance and reforming may be performed. An example of the monitoring device is shown in drawing 8 . In drawing 8 , the monitor of the growth of a fluoride layer is carried out by raising two insulated pins 70 and 72 to the internal surface of the vacuum processing room 10, and measuring the electric resistance of a wall surface with a ohm-meter 74. Since the electric resistance of a wall surface increases

according to the thickness of a fluoride layer as shown in drawing 9 , it can carry out the monitor of the stage which should be carried out reforming by measurement of electric resistance. When not using a ohm-meter 74, it is desirable to lower pins 70 and 72 to under from a sample base or vacuum processing outdoor by the solenoid 76.

[0042] In addition, also when it is not limited to the generating means of the specific plasma at all and generates the plasma using a RF, as for this invention, it is needless to say that it is applicable similarly.

[0043] Drawing 10 is important section drawing of longitudinal section of the inductive-coupling mold plasma generator which performs plasma-etching processing with the application of the principle of drawing 1 . In drawing 10 , the tubed vacuum housing 10 is a product made from an alumina, and the space 50 intercepted by the inside from the outside is formed. The sample base 61 has sample installation side 61A on the top face. Out of space 50, RF generator 80 which is a power source for bias is connected through the matching box 132. The antenna block 134 heated at a heater is formed in the outside of a vacuum housing 10. This antenna block 134 is connected to the power source 133 for plasma generating through the matching box 132. The silicon superior lamella 136 and the heater 138 are arranged at the vacuum housing 10 upside. The insulator 160 is arranged at the vacuum housing 10 bottom. Space 50 is connected to the source 101 of etching raw gas, the source 102 for cleaning of O2 gas, the source 103 of Cl2 gas for reforming, and the source of seasoning gas (graphic display abbreviation) through the gas supply way 100, the gas supply line 105, and the diverter valve 104.

[0044] Since growth of a fluoride layer is pressed down when that vacuum housing 10 is a product made from an alumina, and is the same approach as the example of drawing 3 and this inductive-coupling mold plasma generator etches the wall surface of a vacuum housing 10 etc., even if the etching processing number of sheets of a sample increases, etching processing speed is maintained almost uniformly.

[0045] In addition, an antenna 134 is installed on the up electric insulating plate 136, and there is same effectiveness also with the inductive-coupling mold plasma generator which made the chamber wall 10 the product made from aluminum.

[0046] Drawing 11 is important section drawing of longitudinal section of the parallel plate form plasma generator which performs plasma-etching processing with the application of the principle of drawing 1 . In drawing 11 , a vacuum housing 10 is a product made from aluminum, and the space 50 intercepted by the inside from the outside is formed. The sample base 90 is laid on the lower electrode 63 held with the ceramic 170. The up electrode 62 held with the ceramic 170, the baffle plate 172, and the gaseous diffusion plate 106 are arranged at the vacuum housing 10 upside. The gaseous diffusion plate 106 is connected through the gas supply way 100, the gas supply line 105, and the diverter valve 104 in the source 101 of etching raw gas, the source 102 for cleaning of O2 gas, BCl3 gas for reforming and the source 103 of Cl2 gas, and the source of seasoning gas (graphic display abbreviation). The path 180 of cooling water is established in the upper part and the lower electrodes 62 and 63. 190 is a helium supply path for cooling. The RF power source 192 is connected between the up plates 172 connected to the lower electrode 63 and the up electrode 62.

[0047] That vacuum housing 10 is a product made from aluminum, this parallel plate form plasma generator is also the same approach as the example of drawing 3 , and since growth of a fluoride layer is pressed down by carrying out reforming of the wall surface of a vacuum housing 10 etc., even if the etching processing number of sheets of a sample increases, etching processing speed is maintained almost uniformly.

[0048]

[Effect of the Invention] Since growth of a fluoride layer is pressed down by carrying out reforming of the wall surface of a vacuum housing etc., even if the etching processing number of sheets of a sample increases, etching processing speed is maintained almost uniformly.

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[Translation done.]